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MEASURING PROTECTION OVER TIME. REVENUE AND PROTECTIVE PRODUCTS IN THE 19TH CENTURY EUROPEAN TARIFF GROWTH DEBATE*

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Abstract

This paper shows the relevance of the strong and changing presence of the so-called fiscal products throughout European trade history, the bigger index number problems in periods and countries with higher levels and shares of manufacture tariffs in total imports and the different association between tariffs and growth according to development heterogeneity and the tariff average used. Evidence showed in this paper appear quite contrary to Bairoch traditional hypothesis on the positive role that protection played to foster Continental Europe industrialization before First War World. Conclusions suggests caution in the use of the conventional average tariffs and advises the estimation of alternative manufacture, agrarian and fiscal tariff average by countries as a necessary contribution for the better defined tariff growth debate.

Key words: Measuring protection, tariff-growth debate, fiscal products, European trade policy.

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The relation between trade policy and growth is a fundamental question that require an empirical evidence answer. Measuring the level of protection in an economy through time and across countries is the main problem with which researchers struggle when trying to answer this question. Economic historians and development economist still depend on the traditional and theoretically poorly based measures of protection as the best available instruments to study empirically the relation between trade and growth in the long run. [1] Trade weighted average tariff is the best known measure to isolate tariff policies from other policies and very convenient as a time series index of protection because easily calculated as the ratio of tariff revenues over import values [2].

The motivation of this work is the abundant recent empirical research using average tariffs to establish correlation equations between growth and trade policy in the long run[3]. Positive correlation across countries found between tariffs average and growth during the years of return to protection(1870-1913) by O´Rourke (2000), Clemens-Williamson (2001) and Vamvakidis (2002) strengthened the traditional good reputation between protection and growth at the end of XIX century[4]. Bairoch work was based on a "post hoc ergo propter hoc" argument connecting depression with free trade and economic growth with protectionism.

[1] .- Most of the theoretically founded indices of protection developed recently are impracticable when using time series. Leamer and others index of protection based on a Hekscher-Ohlin empirical model or the CGE (Computable General Equilibrium) models, require knowledge of the basic production structure and when the imput-ouput data is available it is feasible only for some isolated years. For a Heckscher –Ohlin model with some empiricall asumption on factor endowments see : Leamer (1988) and for a comparative historical study in 1913 EstevaDeordall (1996). A CGE model derived from and imput-output coeficients for Itlaly in 1911 see Federico O´Rourke (1999). Even the most simplified GCE models as the Anderson TRI (Trade Restrictiveness Index), which does not require knowing the production structure of the country, rely on import and tariff data disagregated enough to make the index only empirically feasible for benchmark comparison. For the theoretic of the TRI model see Anderson_Neary (1996), and Anderson (1998) for a comparative study in 1989-1990. A critic of the model in an economic-history context O'Rourke (1997). Application of the TRI in economic history see Federico-Tena (1997) for Italy and Tena (1998) for Spain.

[2] Edwards(1993) still uses imports-export to GDP ratios to obtain a classification of the openness of the countries for the second half of the XX century. The equilibrium ratio level of this measure relies on the size and changes in demand structure trade elasticities that make this measure endogenous and unconvincing for the long run. For the post war years review of the empirical studies on trade policy and economic growth see Rodriguez-Rodrik (1999).

[3] There are many reasons for the use of tariff average as protection index in the long run. Edwards (1998) runs regression of total productivity growth on nine alternative indicators of openness, only three results are statistically significant being trade tax ratio the only one not being a complex arbitrary variable constructed by an Institution.

[4] " Although import substitution policies have gradually lost their shine over the postwar period, their reputation has remained intact for the late nineteenth century" Irwin (2002), p.1. Notably Bairoch (1976, 1989, 1996) praise protectionism as instrumental to the development of late XIXth century Continental Europe.

Previous works show new evidence supporting Bairochs hypothesis and suggest causality between higher tariffs levels and growth. Nevertheless these recent works provide scarce information to interpreting the tariff mechanism causation to growth. The main suggestion of this paper is that total tariff average indices provide not only scarce information, or important bias to interpreting the tariff mechanism causation on growth but lead to erroneous conclusions.

This paper discus three criticism that make the use of average tariff to establish causal relationship between tariff and growth specially vulnerable. First, the well known "index number problem" of the tariff import weighted average that usually downward biases the most protected goods import weight. The extent of the bias depends on the height of the current tariff rate and on the elasticity of imports of the most important goods [5] . A country which imposes prohibitive tariffs on all goods but one (imported free) would appear less protectionist than another which raises a uniform 5 per cent duty.

Second, there are some luxury consumer products which were traditionally costumed for "fiscal reasons" in Europe specially during the prewar years, because their low elasticity of demand allowed for increases in tariffs and more revenue [6]. The inclusion of this kind of products on protection measures hinged on the specification of demand and in particular on how exotic products should be treated. The revenue tariff is related mainly to consumer income and government revenue and its economic effect is more similar to a "sales tax" over certain luxury products such as tobacco or gasoline. In theory there are no pure fiscal tariffs neither pure protective ones. However those which have a small elasticity of demand (fiscal tariff) have much lower impact on welfare and import substitution than those with high elasticity [7]. The strong presence of the so-called fiscal products and their changing presence

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[5] For an extension of index number problems in tariff averaging see Tumlir- Till (1971)and Federico-Tena (1998)

[6] .- This is only a general statement as protective tariffs can also increment revenue tariff. Irwin (1998) measures import elasticity for the USA at the end of 19th century and shows how higher tariffs in protective products can raise additional revenue. strictly speaking it depends on the import demand elasticity and if the previous level of the tariff is below the revenue maximizing tariff.

[7] .- O'Rourke(1997) present this argument in the context of the discussion of the applicability of the Anderson TRI CGE model to resolve the Nye-Irwin debate. He concludes that when there are a high proportion of low elasticity demand products in the imports demand of a given country, the specification of the import demand elasticity's are crucial to the determination of the impact of the import tariff structure on the welfare of an economy.

throughout trade history makes this point important in the analysis of the comparative evolution of the international trade policies specially in Europe.

The third is an extension of the previous criticism and is related with the use of the tariff average to advocate the positive role of import tariffs to promote growth (Bairoch (1977), (1989), (1994) O´Rourke(2000), Clements-Williamson(2001)). For Continental Europe this mean that, at least for the period 1870–1913, that tariffs should be perceived as a a successful policy to foster industrialization. European economic growth at the end of the XIX century imply foster industrialization, and this follow that tariff should encourage structural change from agriculture to industry to raise output per worker this may imply lower agricultural protection and higher industrial tariffs[8]. This paper test the relevance of this critics on the use of tariff average either for the tariff growth debate or the clarification of the comparative European commercial policy history during the XIX century.

The first section, discuses Nye´s provocative statement of a more free trade France than UK before 1880 pointing out the relevance of the fiscal share in costume revenue tariff average for that debate. The second section estimates the level and changing share of fiscal products in other European countries and their relevance for the European comparative commercial policy histories in the last quarter of 19th century. The third section discuses the index number problem in the conventional tariff average and tries to measure the import contraction tariff elasticity for Spain and Italy and its relevance during the years of return to protection. The fourth section investigates the causation mechanism between tariffs and growth finding different results between industrial and total tariffs correlation with growth. The concluding remarks show the relevance of the strong and changing presence of the so-called fiscal products throughout European trade history, the bigger index number problems in periods and countries with higher levels and shares of manufacture tariffs in total imports and the different association between tariffs and growth according to development heterogeneity and the tariff index used. All this evidence suggests caution in the use of the conventional average tariffs and advises the estimation of alternative manufacture, agrarian and fiscal tariff average by countries as a necessary contribution for the better defined tariff growth debate.

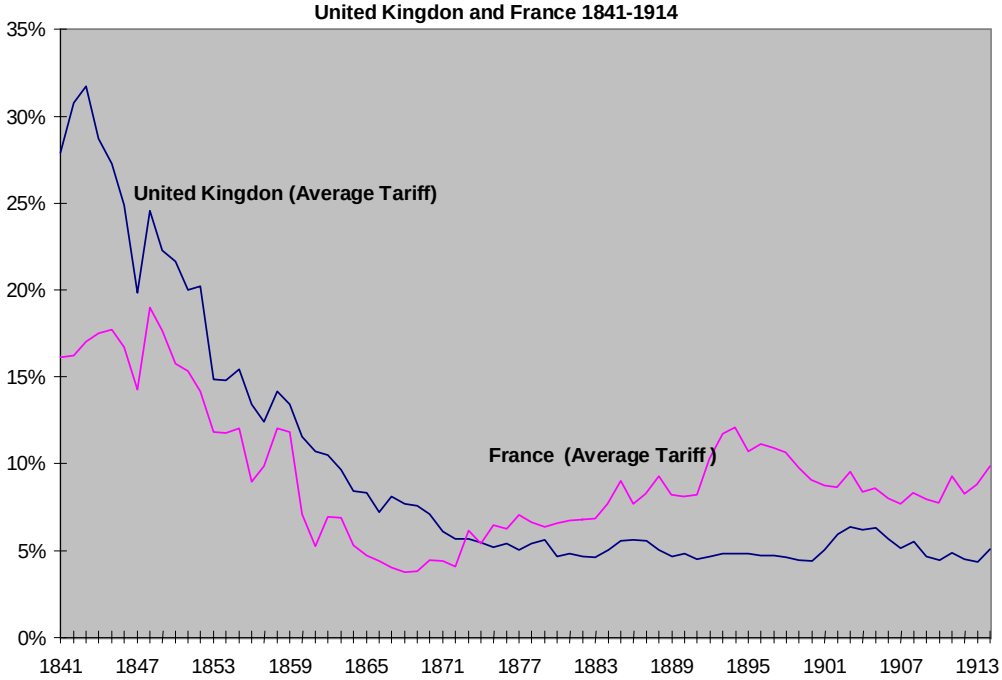
1.- A cautionary tale: fiscal British versus protective France

The share of revenue products in the nominal protection average index is part of a recent debate about the comparative experience with trade policy in France and United Kingdom during the 19th century (see Nye (1991, 1993) and the debate Irwin-Nye (1993)). Nye's main proposition is that the comparative nominal protection average index of both countries support the argument of more free trade in France than in UK, especially between 1840 and 1880. That statement is reinforced testing average tariff index number problems applying the tariff rates by commodity class to the import distribution of another period close to free trade. After some other qualifications on average tariff robustness for England and France Nye refuses to accept that there is an economic argument to establish distinction between fiscal tariffs and less protective in the United Kingdom and manufacture tariffs and more protective in France. Protection bias either in England and France was designed in defense of non-comparative advantage products. Irwin argues that the big share of revenue tariffs in UK imports in that period is the main responsible of the upward bias of the British tariff average. In United Kingdom fiscal tariffs taxed only exotic products not produced in England as "an extension of the domestic excise system, levied only on a select number of commodities to raise fiscal revenue without discriminating against foreign goods in favor of domestic goods" [9]. That would be the case of brandies or even beer, for which an excise duty that had to be paid and offset the wine duties. Nevertheless we do not know how much of the difference between the higher British average tariff and the lower French level is due to the presence of revenue products. Irwin's reply uses good qualitative arguments but no consistent quantitative evidence. The share of the revenue tariffs on the average index emerges as the main contrasting point in the representation of such different stories.

[8] This proposition is suggested also in Irwin (2002)
[9] See Irwin (1993), p.

Figure 1

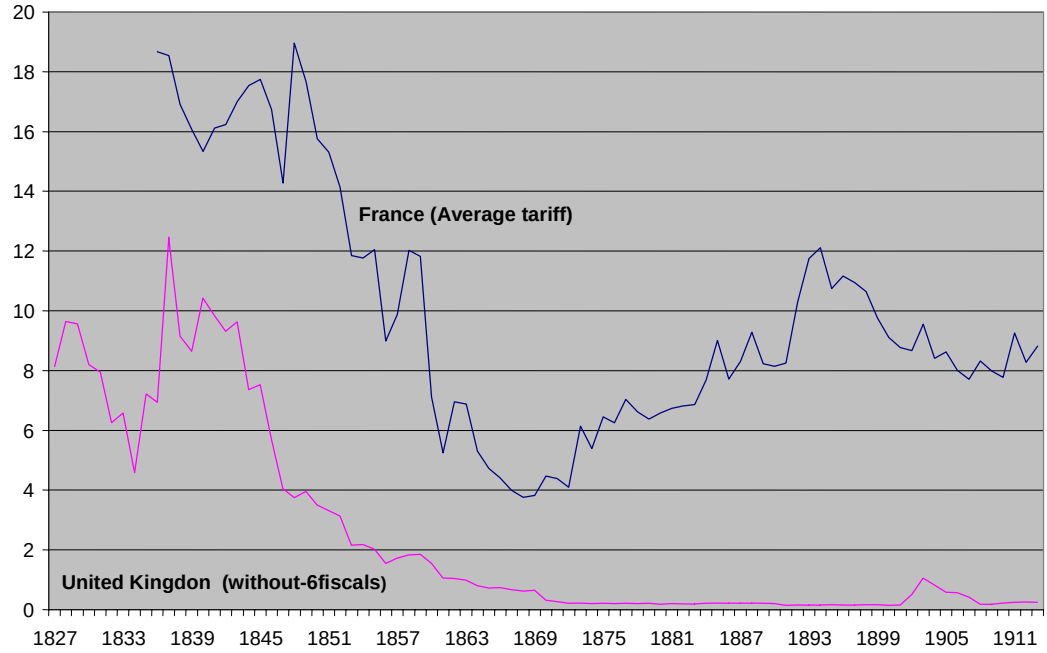
Average Tariffs Rates: (Tariff Revenue as a Fraction of All Imports) in United Kingdon and France 1841-1914



Sources: see Appendix 1

Figures 1, 2 and 3 offer visualized quantitative evidence of the different positions given in the Nye-Irving debate with the purpose to shed some light on the importance of fiscal products in British and French protectionist histories rather than to resolve the debate. Nye argues that exotic stuffs and beverages in England were used as an important source of revenue, but those tariffs induce protection for direct and indirect substitutes. Fiscal tariffs distorted domestic production and consumer welfare in Britain , as the protection of textiles manufactures did in France. On the basis of this argument, Nye insists that Figure 1 represents acceptable quantitative evidence of the comparative commercial policy history of both countries and supports the provocative argument of more free trade in France than England even after the English corn law repeal in the 1840´s and before the turn to protection in France in the 1880´s.

Figure 2
Average Tariffs Rates France United Kingdom (U.K without main fiscals)



Sources: see Appendix 1

Figure 2, makes explicit the conventional and well-accepted argument defended recently by Irwin. British protection from the 1840´s on, was mainly fiscal. Leaving out the English main fiscal products in dispute, there is no question about the representation of the traditional view of a comparatively free trade England with protectionist France. Irwin insists on the fact that the English tariffs on wine and spirits were "carefully constructed to avoid protecting domestic producers"(sic)[10] . Tariffs on wine and foreign spirits were required to allow British domestic producers of beer and spirit, who were taxed with an excise, to compete, on equal terms, with these imported foreign beverages. So tariffs on brandies and even on wines did not have relevant protective effects on domestically produced beverages and should be treated as fiscal products like other exotic colonials imported as tea, sugar, tobacco and coffee.

[10] Irwin (1993) p.146. This argument is part of a well-accepted fiscal history in England. For a very recent British fiscal history see Martin Daunton (2001). In a summary of it main conclusion(see Dauton (june 2001): Dauton insists that: "excise duties were, "voluntary" , falling on goods such as tobacco or spirits which the tax payers could do without – they might even be morally suspect narcotics. Import duties were limited to commodities which could not be produced at home (such as sugar or tea), so that they did not offer any

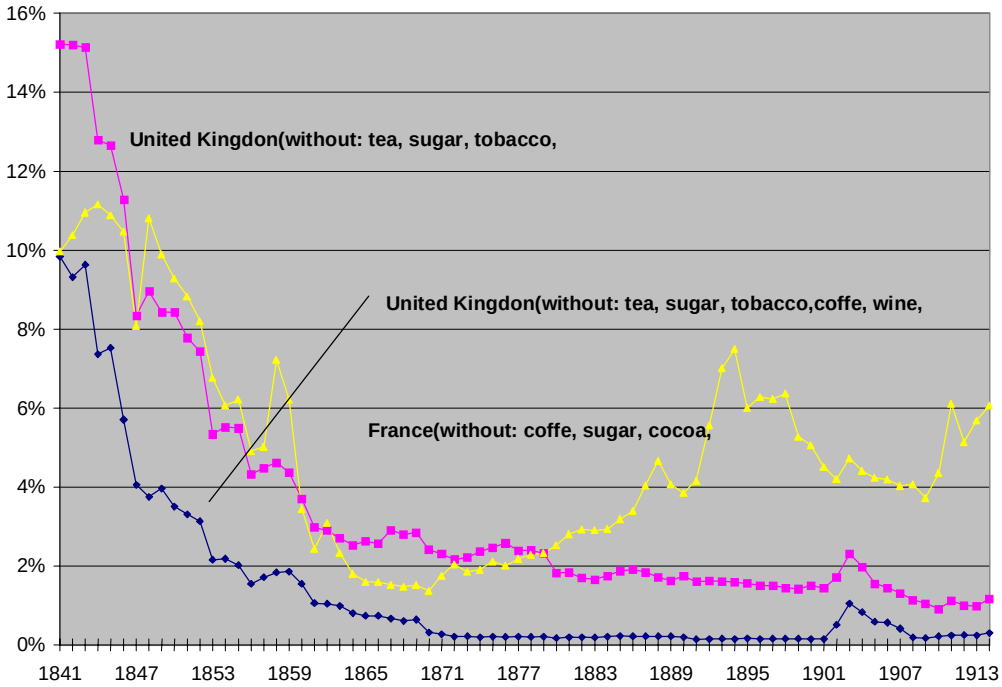
Neither Irwin nor Nye pay too much attention to the growing share of French fiscal products in total tariff revenues during the period in question. The share of colonial products like cocoa, coffee, and sugar in France represented more than a 40 percent of the average tariff rate index in the second half of the 1840`s and grew over 60 and 70 per cent in the 1860´s and 1870´s. So comparatively, the trend of France's nominal protection was strongly influenced by fiscal tariff products too. A consistent comparison between both countries suggests measuring the incidence of revenue products in the French average tariff too.

Figure 3 does this, first, excluding the respective four main revenue products in each country and second, removing spirits and wine, the two controversial English excise taxed products. The first exercise would show the parallel free trade histories for both countries during the 1840´s. France would be more liberal than England before the abolition of Corn Law. The famous liberalizing British decade of the 1840s leaves the average tariff level slightly lower than that of its rival before 1860´s but both countries would show quite similar levels before the 1880`s. After the Cobden –Chevalier Treaty France's liberalizing efforts would allow to outdo slightly the British free trade performance, during almost two decades, before the 1880s return to protection.

protection to domestic producers, with the danger of distorting the allocation of resources in the economy.", p.10

Figure 3

Nominal Protection(Average Tariff Revenue as a Fraction of Total Revenue) Without Main Fiscal Products in United Kingdom and France 1841-1914



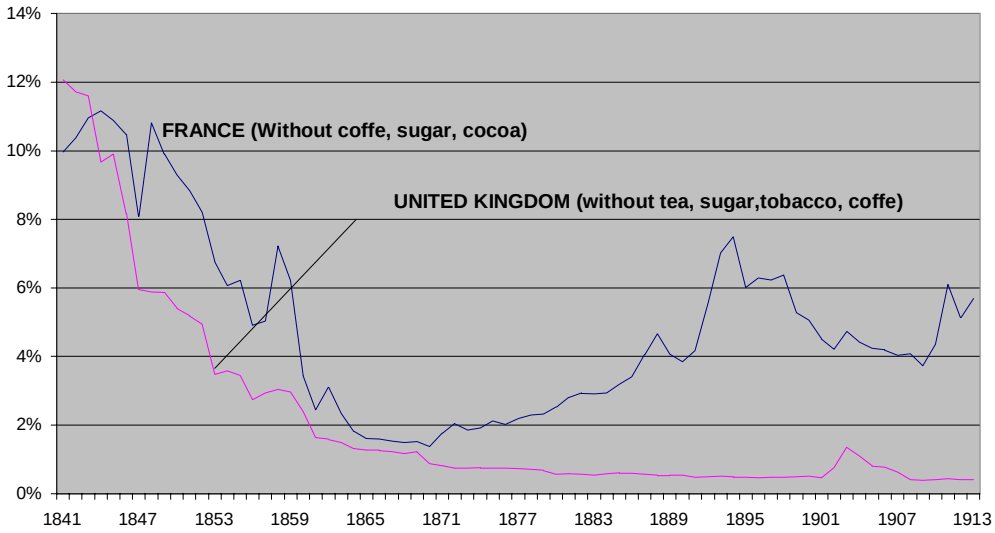
Sources: see Appendix 1

The second UK index presents better the conventional well known commercial comparative history defended by Irwin. The controversial wine and spirits (excise taxed) imports and revenues are removed from the average tariff. Peel's efforts of the 1840´s would reduce the British tariffs average in a significant way both in absolute terms and in comparison with France's average. France followed England tariff reductions in the 1850´s and the Cobden-Chevalier 1860´s decade shows a faster liberalization in France than in England but England would remain in the premier free trade position all along the XIX century.

Wine, rum and brandy tariffs and the excise level of their substitutes beer and domestic appear crucial in this debate. Figure 9 (Appendix A) add some evidence to the debate estimating the ad valorem spirit tariff ratio and its respective ad valorem excise ratio over production from 1840 to 1913. The spirit tariff fell to half in 1840 but still during the 1840´s decade was maintained slightly over the excise ratio. Only in the second half of the 1850´s this trend change abruptly and in the next two decades the excise tax became twice higher than the tariff protection of the sector. Figure 10 (Appendix A) pays attention to the

Figure 4

Average Tariff Without Main Fiscal Product in United Kingdom and France



relation between wine tariff and the beer excise ratio. The wine tariff was more than four fold the ad valorem excise ratio over beer, their main substitute produced in United Kingdom.

The excise was reduced strongly in the second half of the 1850´s in correspondence with the Cobden-Chevalier negotiations. In the next decades the wine tariff appears always close to double the beer excise. In consequence evidence on tariffs and excise supports a reasonable compromise between both positions. Wine tariff seems independent of excise beer and may have had influence on beer domestic production, so it may be considered protective. On the contrary, spirit excise seems to have offset its tariff barrier, so it may be considered fiscal.

Figure 4 offers this compromise. Spirits are excluded because excise taxes offset protection over national brandies production (as Irwin suggests). But wine is included and considered a protective tariff , because apparently the beer excise tax did not compensate the wine tariff at all (as Nye insists). The new British index reproduces mainly the well-established British commercial history. The 1840´s that saw the beginning of a true revolution in commercial history. Earlier moves towards freer trade had been conditioned by an

insistence on reciprocity, but from 1840s on policy was determined unilaterally. The Repeal of the Corn Law in 1846 is shown by the index as a radical change even if tariffs reduction appear from the beginning of the 1840s. French tariffs reductions started later, at the turn of the decade, and were less dramatic than in England. During the 1850´s French tariff levels almost double the British ones and convergence is only significant after the 1860 treaty and steadily persists until 1870. French reactions against liberalization appear early in the 1870s and were progressive until the end of the 1880s with an acceleration in the early 1890s with the new Meline tariff law.

O'Rourke arrived at similar conclusions about the Nye-Irving debate using a CGE model: *"If wine, rum and brandy are not treated as exotic, but are assumed to be as substitutable with British goods as imported wheat or timber, then Nye is spectacularly right."(p. 180).* O'Rourke did not take into account exotic products that were excise taxed or not. Evidence on fiscal revenue and excise taxed makes Nye history less spectacular, and more reconcilable with the main stream of the well-established British trade history. Nevertheless, Nye's provocative statement is really a cautionary tale suggestive for other histories of commercial policy and push us to pay more attention to the fiscal products in costume revenue when tariff average are used to study commercial history through time or in comparative history.

2.- Revenue and Protective Tariffs in 19th Century Trade Policy History

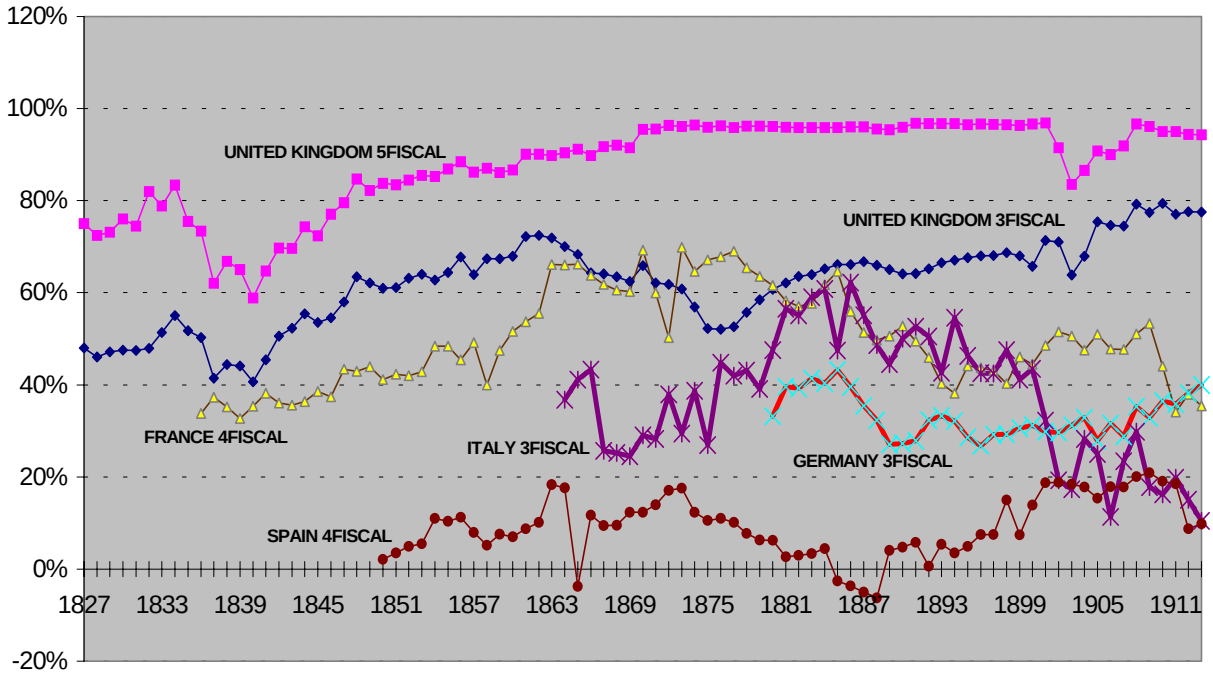
Generally speaking, fiscal tariff commodities, are those which had no direct domestic substitutes[11]. Without demand elasticity specification we will make the decision to consider fiscal products, for our purpose, as the highest revenue commodities with no obvious domestic substitutes. The revenue tariff is related mainly to consumer income and government revenue and its economic effect is more similar to a "sales tax" over certain luxury products such as tobacco or gasoline. In theory there are no pure fiscal tariffs neither pure protective ones. However those which have a small elasticity of demand (fiscal tariff)

[11] .- The United States protectionism history is a paradigmatic case of a strong government revenue dependence on tariff revenue before 1914. Nevertheless, revenue tariffs taxed products were mainly domestically produced. Because of its extension and variety of climes were perhaps an exceptional producer of almost every "exotic" consumed product (perhaps the only exception was cane sugar (only produced in small quantities in Louisiana). Irwin (1998) show the different behavior of the general index with and without sugar in the general index but not so significant as we show here for some European countries.

have much lower impact on welfare and import substitution than those with high elasticity [12]. The assumption is that a low elasticity of demand is a consequence of non existence of clear domestic substitutes (elasticity of substitution close to zero) , even if it depends also on home market size and stage of development (see O`Rourke (1997), Irwin(1998), Krueger (1997). In consequence an average tariff without fiscal tariffs would probably represent a better index of protection than the conventional one in which they are included. We offer some evidence on how exotic products without obvious substitutes such as sugar, cocoa, tea or coffee represented a significant fraction of European imports and the relevance of this distinction for the comparative XIX century trade policy history.

[12] .- O'Rourke(1997) present this argument in the context of the discussion of the applicability of the Anderson TRI CGE model to resolve the Nye-Irwin debate. He concludes that when there are a high proportion of low elasticity demand products in the imports demand of a given country, the specification of the import demand elasticity's are crucial to the determination of the impact of the import tariff structure on the welfare of an economy.

FIGURE 4
MAIN FISCAL TARIFF SHARE IN TOTAL AVERAGES TARIFFS IN SOME EUROPEAN COUNTRIES 1827 -1913

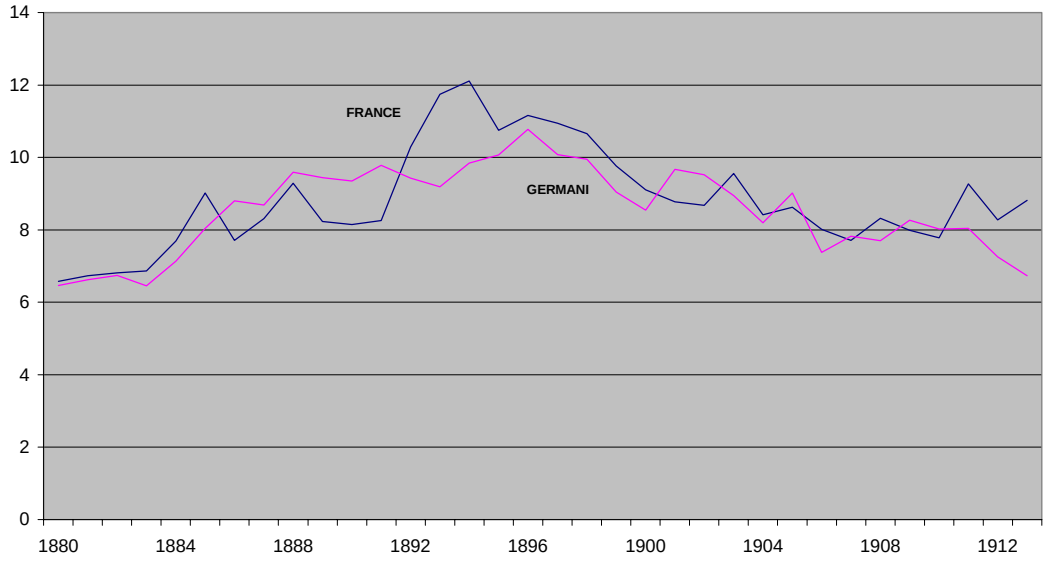


Sources: Appendix 1. United Kingdom (4 fiscal): tea, sugar, tobacco, coffee, (6 fiscal): four fiscal plus wine and spirits. France (4 fiscal):cocoa, coffee, sugar and petroleum. Germany (3 fiscal): coffee, tobacco and petroleum. Italy (3fiscal): sugar, coffee, petroleum. Spain (4 fiscal) sugar coffee, code and petroleum.

Figure 4 shows the changing share of the main fiscal tariff average on total tariff average in some European countries throughout the XIX century [13]. The tariff rate on fiscal products represent for the United Kingdom (4fiscal) between 40 to 80 per cent of total tariff average in a growing cyclical trend from the 1820´s to First World War. In the case of France this share increase from 35 per cent in the 1830`s to a share of 70 per cent at the end of the 1870´s to go down around 40 per cent at the turn of the XIX century. Germany, on the contrary, shows a more moderate and constant influence of the fiscal rate on the total average with a cyclical share in the range of 40-30 per cent. The share trend of the main fiscal tariff average in the total tariff average for peripheral countries like Spain and Italy is also quite

[13] That means the difference between the total tariff average with and without fiscal duties as a percentage of the last. This represent the changing share influence of fiscal products on total conventional nominal tariff along the time and between countries.

Figure 5
Average Tariffs Rates in France and Germany 1880-1913



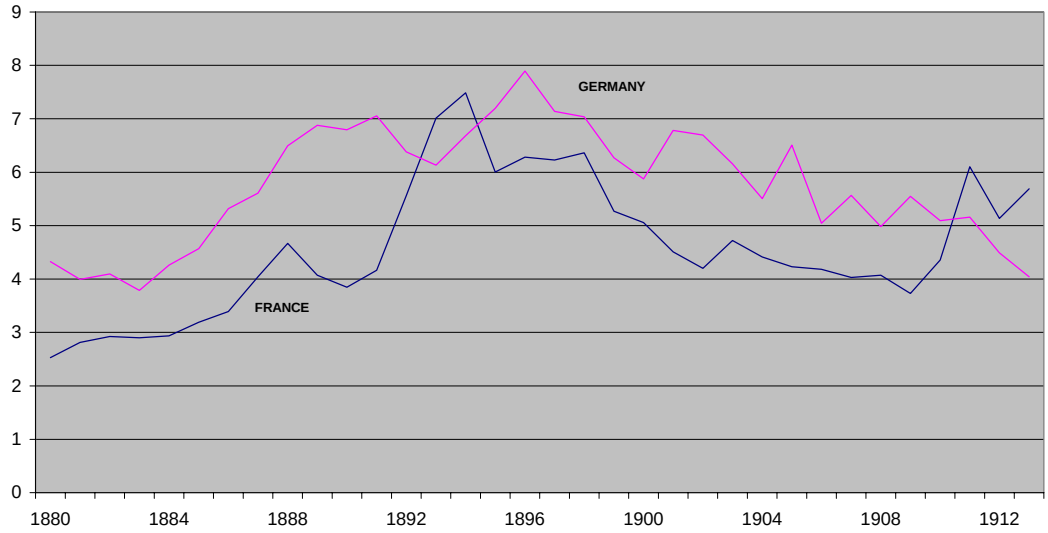
shocking with a range that goes from – 5(lower than the average) to 20 for the first to 20-60 for the second.

Sources: Appendix 1

On the basis of these changing shares of fiscal products in the total average we can get a different perception of the comparative protectionist history in Europe. The conventional Bairoch (1989) history about tariffs for the period of "return to protection" of France and Germany between 1880 to 1913 is only confirmed partially if we do not take into account the fiscal product share in the average rate, as we did in previous section with the France and Britain.

The conventional tariff average of Figure 5 shows how Germany did not lead the early return to protection in Continental Europe. France's comparative reaction appears at least so early and severe as the German one, reaching a significantly higher level than Germany during the first half of 1890`s. After the second half of the 1890´s and until First World War, protection was decreasing, because price increase reduced the level of ad-valorem equivalent of the (specific) duties.

Figure 6
Average Tariffs Rates in France and Germany Without Main Fiscal Products 1880-1913



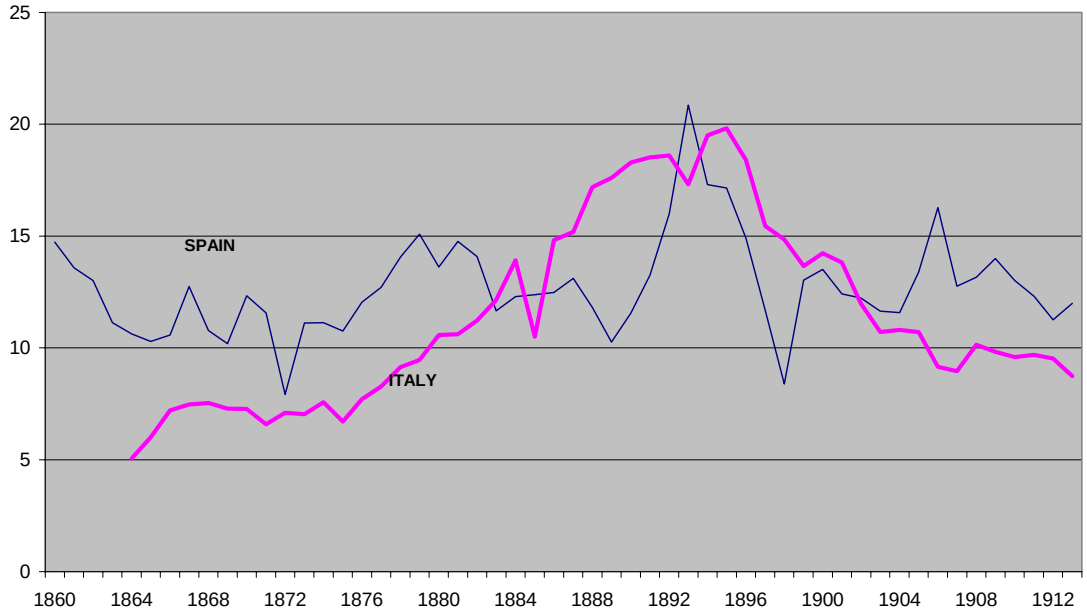
Sources: Appendix 1

An alternative history appears, when the exotic products are left out of the average, as shown by figure 6. Germany's early return to protection in the 1880´s decade caused by the steady reinforcement of its famous July 1879 tariff law appears clearly identified, with levels almost twofold of the French ones at the end of decade. Only in the next two years that follow the respective French tariffs laws of 1892 and 1910, French average appear higher than the Germans. Also in this case, the German average would offer superior levels than its French counterpart following better the qualitative perceptions of the literature for the period of the return of protection.

The last cautionary tale on the use of fiscal products on tariff average affects the commercial history of two peripheral countries like Spain and Italy. Italy during the twenty years after unification was a free trade country, a shorter and doubtful free trade period for the Spanish case initiated in the second half of the 1860´s. Spain's new tariff of July 1877 introduced for the first time the double tariff that was to be adopted by many other European tariff laws in the following years. Italy tariff law of 1878, even if it was moderate, was previous to the 1879 German tariff. Most scholars date the real beginning of protection in Italy with the approval of the new tariff of 1887 and in Spain with the Canovas Law of 1891. The Italian 1887 tariff implemented a new a duty on wheat and manufactures that caused an

open trade-war with France, then Italy main trading-partner. The 1887 tariff lasted officially more than thirty years with some minor interventions, ad-hoc laws, and trade treaties. From the second half of the 1890´s the level of protection was decreasing as price increases reduced the level of the ad valorem equivalent of the (specific) duties. Spain's protectionist tariff of 1892 provoked also a tariff war with France and Germany. In addition the loss of her remaining colonies (Cuba, Philippines and Puerto Rico) in 1898 reduced exports and induced a strong pessimism that led to pressures for increased protectionism which resulted in the new tariff law of 1906[14].

Figure 7
Average Tariff Rates: Tariff Revenues as a Fraction of Total Import Value in Spain and Italy 1860-1913



Sources: Appendix 1

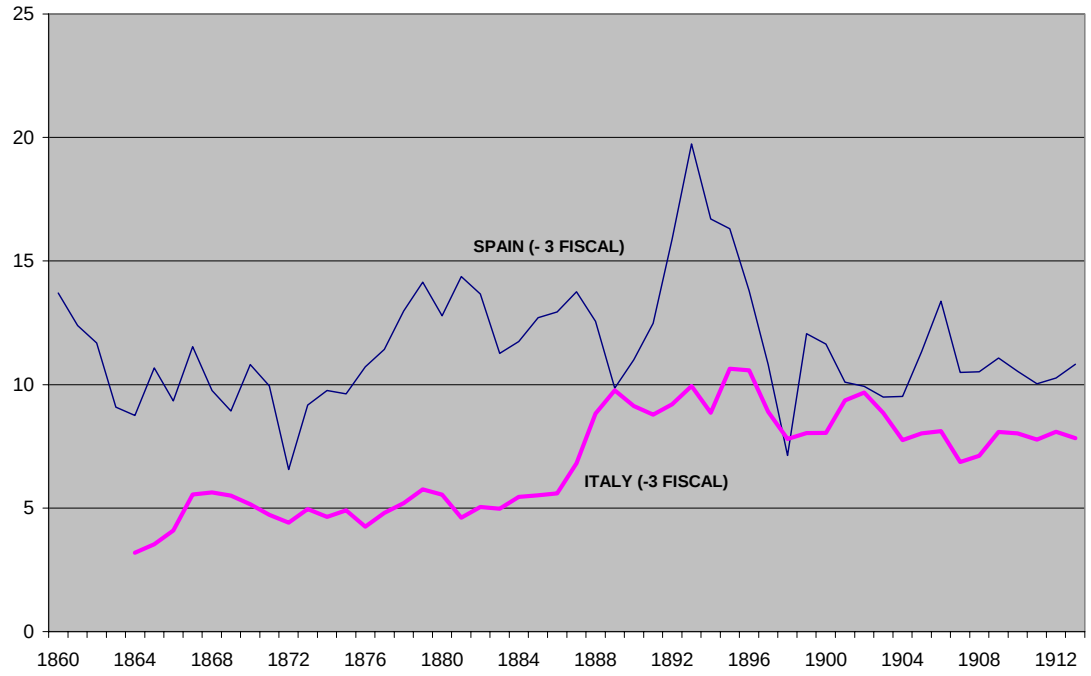
On the basis of this qualitative evidence historians had widely assumed that both countries had a similar protectionist histories. A look at the comparative conventional ratio of total tariffs incomes on import value in figure 7 partially confirms this conventional wisdom at least for the years of the return of protection. Protection increase in Italy from the late

[14] See Tena (2000)

1870´s on but it is not until the late 1880´s that the tariffs average would arrive at a level similar to the Spanish average because of a linear constant protection increase until the turn of the century. In Italy the level of the tariff average decreased from the turn of the century to First World War in contrast with the stabilization of the Spanish average in the same years. The Spanish protectionist index does not fit with the idea of a temporary return to protection as the Italian one and it appears more as a structural cyclical feature of the Spanish economy from the second half of the 1870´s. Nevertheless from the second half of the 1880´s decade to the first years of the turn of the century Italy would show superior average tariff levels than the Spain.

During the years of "return of protection" around half of total costume revenue in Italy was yielded by three products sugar, coffee and oil and in Spain three main revenue products (cod, coffee and oil) yielded around 1/5 of total (total colonials ¼). As Figure 4 shows the weight of fiscal tariffs in the total average tariffs was much higher in Italy than in Spain and the trend of that weight was practically the inverse during these years.

Figure 8
Average Tariffs Rates Without Main Fiscal Produsts in Spain and Italy 1860-1913



Sources: see Appendix 1

Figure 8 shows that, without its three main revenue products, Italian free-trade period can be clearly extended until the 1887 tariff law (with no years above 6 percent). The increase of protection was much less impressive than when fiscal products are included, with higher peaks around a 10% during the 1890´s. This means that one cannot understand the structure of Italian duties without taking into account the fiscal side of the issue. Italian fiscal duties` increased relevance is noted from the end of the 1870´s and influences the significant custom revenues growth of the following years without affecting imports substantially. Fiscal protection accounted for about three quarters of the rise in total protection from 1877 to 1897 (Federico and Tena 1998, Table1). In Spain the main fiscal duties were imposed after the 1898 Cuban's war, following the fiscal reform of Fernandez Villaverde in 1899, when fiscal tariff revenues of the so-called "Colonials" were increased notably. Nevertheless, even if fiscal products affected domestic colonial product prices, they do not alter significantly the trend and the level of the Spanish total protectionism, because of their lower share in total imports. The comparative nominal protection average index, for the crucial decade of 1890, shows a very similar increase in aggregate protection for both countries. But Italian protection increment was mainly fiscal and the Spanish mainly due to tariff increase in manufactures (Federico-Tena (1998), Tena (1999)

3.- Manufacture versus fiscal tariffs and the classic index problem.

The tariff average index $NTt = \sum_{i=1}^{n} (Q_{it} * T_{it}) / \sum_{i=1}^{n} (Q_{it} * P_{it})$ [1] is a Paasche index that weights individual tariffs by the respective imports in each year. So a classic index number problem arises because when Ti is increased Mi declines. This mean that, the conventional average tariff NT usually biases the results downwards and the extent of the bias depends on the level of the duties and on the elasticity of imports of the most important goods.

An alternative index would be the UNT. Which does not weight at all (simple average of duties) $UNT = \sum_{i=1}^{n} Ti / n$ [2] and assumes that each item had the same share in consumption, which is clearly implausible. The UNT bias is (roughly) inversely proportional to the number of products (Tumlir-Till 1971), which depends on the layout of trade statistics. Usually, they are more detailed for manufactures, which therefore may be

given an excessive weight. The RNT, the composition of trade of the same country in a previous year, as suggested by McCloskey (1980), $RNTt = \sum_{i=1}^{n} (Qi_{t-1} * Ti_t) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t-1})$ [3] which is conceptually equivalent to a Laspeyres price index, exactly as the NT is a Paasche price index (with current price weighting) is possibly the most appealing measure, provided it were possible to find a "free-trade" year close enough to the relevant one. However, this condition is hardly met in historical research, as the protectionist policy lasted for decades, while the economies were changing.

Therefore, there is no ideal solution as yet to the problem The "true" level of protection at any given point in time, can not be ascertained. The best practical compromise seems to be to compute all the measures and assess their consistency. This strategy yields a further bonus, as the comparison between different measures provides an insight on the causes of changes in the level of tariff average (NT-NTt-1), before and after a tariff law change. Usually, the variations are attributed to changes in trade policy, but this is not necessarily the case. The overall level of protection can change also if duties remain constant, either because the composition of trade varies (as a result of trade policy itself or for any other reason) or – in the case of specific duties- because changes in world prices (absolute or relative).

It is possible to disentangle these three causes, by computing

[NTt-NTt-1] = [NTt-RNPt] + [RNPt-RNTt] + [RNTt-NTt-1] [4]

where NT is defined as in [1], RNT as in [3] and RNP as

$RNPt = \sum_{i=1}^{n} (Qi_{t-1} * Ti_t) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_t)$ [5]

(Appendix 3 expand this decomposition for clarity)

Each component on the right-hand side of [4] measures how much the aggregate protection (NT) would have changed ceteris paribus. The first term, or quantity effect, estimates the variation that would be caused by changes in the composition of imports if duties and prices remained constant. The second, or price effect, measures. The second term, or price effect, computes the change which would be caused by changes in prices ceteris paribus duties and demand structure constant. The third one, the tariff effect estimates the variation that would be caused by a change in tariffs with unchanged world prices and composition of imports – i.e. the effects of trade policy (i).

As we mention before NT change is usually downwards because when duties increase the import quantities decline and the extent of the bias depends on the elasticity of imports contraction. So we can use the decomposition of changes in nominal protection in equation [4] to measure the elasticity of imports contraction as the ratio of quantity decline in proportion to tariff increase and price changes. The smaller duty increase and bigger the quantity decline the bigger the downwards bias when NT change (or the index number problem).

Table 1

Decomposition of changes in Total Nominal Protection [NTt-NTt-1]
During the years of return of protection in Spain and Italy

SPAIN 1897-1889	Tariff (1)	Price (2)	Quantity (3)	Import elasticity (4)= (3) / [(1)+(2)]	NTt-NTt-1
Total	6.8	0.9	-4.1	-0.53	3.6
Industrial goods	8.5	-0.5	- 5.8	-0.72	2.1
Primary Prod	5.6	1.8	-2.3	-0.31	5.1

ITALY 1889-1877	Duty (1)	Price (2)	Quantity (3)	Import elasticity (4)= (3) / [(1)+(2)]	NTt-NTt-1
Total	13.1	0.9	-3.7	-0.264	10.3
Industrial goods	15.1	-4.4	-1.3	-0.121	9.4
Primary Prod	11.8	6.6	-7.8	-0.438	10.6

Table 1 shows the decomposition of Nt change in Italy and Spain during the years of return to protection after the respective main tariff laws of 1891 and 1887. The first fact is that Italy return of protection between 1877 and 1889 measured by NT increment was more than 10 points and the Spanish return of protection between 1889 and 1897 measured by NT was only of a 3.6 points increment. The comparative decomposition of the NT change shows that the elasticity of import contraction (0.26) in Italy was less than half that of Spain(0.53). This mean that the Spanish return of protection measured by NTt-NTt-1 is clearly downwards bias by a strong import contraction (almost by half) meanwhile in the case of Italy the contraction was less than a quarter. The elasticity behavior of the Spanish industrial goods was even higher (0,72) and around six fold that of Italy(0.12). In contrast

Italy´s primary products elasticity show elasticity coefficients slightly superior to those of Spain. So it is clear that the Spanish industrial protection elasticity during the years of return of protection was the main responsible of the big elasticity of total imports and Industrial protection measured by NT was especially downward bias in absolute terms and in relation with the Italian NT. As it may be expected that the Spanish Industrial goods elasticity more than double that of Primary goods but it is contra intuitive that in the Italian case it happened the other way around. Import contraction depend also of the base year tariff level. In the case of Spain Industrial tariff level in 1889 was higher than for primary products and the inverse situation happened for Italy in 1877 (see Table 2).

So evidence showed by table 1 support the argument that the Spanish tariff average change between 1889 and 1891 is specially downwards tariff of return of protection was implemented over a high level of protection of previous years for industrial goods and posterior industrial tariffs increments show a special high elasticity for imports contraction. In consequence the conventional average tariff is specially downward bias or affected by the index number problem.

Table 2

Alternative nominal protection indices in Spain and Italy 1870-1930

		(1)	(2)	(4)	(5)	(6)	(7)
		NT	**NT**	**UNT**	**UNT**	**NT / UNT**	**NT / UNT**
		Spain	**Italy**	**Spain**	**Italy**	**(Spain)**	**(Italy)**
1877	Total	12.7	7.3	17.7	6,8	0.72	1.07
	Manufact	17.6	6.5	22.4	5.4	0.78	1.2
1889	Total	11.0	17.6	16.7	16,9	0,66	1.04
	Manufact	13,8	16.9	17.6	15.6	0.78	1.08
1897	Total	14.6	18.5	26.3	16.1	0.55	1,15
	Manufact	18.4	13.2	32.4	15.2	0.56	0.87
1913	Total	14.9	9.6	25.2	12.7	0.59	0,75
	Manufact	15.5	9.3	23.6	11.9	0.66	0.78
1926	Total	15.5	11.9	26.6	13.7	0,58	0,87
	Manufact	26.0	15.0	35.9	15.7	0.72	0.95

Sources: Spain: Tena (1999); Italy: Federico-Tena (1998)

Following Tena (1999) for Spain and Federico and Tena (1998), for Italy, it is possible to test the robustness of NT in contrast with the other trade measure UNT (simple average). Table 2 reports the results as ratio of the NT in relation with the most common simple average (UNT). Some facts could be pointed out: first that the Spanish NT/UNT ratio is always lower than the Italian one; second that the downward bias of the Spanish index grows in the years after main tariffs laws (1897, 1913 and 1926); third that the distance between these ratios increases significantly in the Spanish case in 1897 in relation with previous years. On the other side the Italian average ratio is only below 0.80 in 1913, but in the rest of the years there are no significant contraction of the ratios far from 1. The minor bias of the Italian NT index in 1889 and 1897 in relation to the Spanish, points out two facts: first that the Spanish 1891 protectionist law contrast greater imports of the more protected sectors, second that Italy´s tariffs were lower and this can be the consequence of Italy implementation of lower tariffs and that they affected mainly to the lower elasticity demand sectors.

Table 3
Major components of the "Return to protection"
Spain(1897) and Italy(1889)
(Total protection as NT,UNT and RNT arithmetic average)

	PRIMARY PRODUCTS	Wheat	Sugar	Sugar Petrol Coffee	**SEMIMANUFACTURES**	Iron Steel	**MANUFACTURES**	Textiles
1877-1897 SPAIN	**34%**	23%	-14%	7%	**11%**	16%	**55%**	45%
1877-1889 ITALY	**62%**	9%	23%	53%	**17%**	7%	**21%**	13%

Sources: database Spain (see Tena (1999), Italy: Federico-Tena (1998). (*) Italy 1889 average NT y UNT because technical absence of RNT in the 1877 year.

Table 3 measures the contribution of a significant group of products and sectors from the 1870´s to the total increment of protection after the respective "return to protection" in Spain and Italy. The contribution of every sector is the result of the difference between the real total average of protection (as average of NT,UNT and RNT) and the counterfactual average estimated keeping stable tariffs and demand in the sector before and after the introduction of the respective new tariff laws in each country (Spain 1897 and Italy 1889). The main contribution of the "return of protection" in Italy came from the increasing primary products tariff and especially from a small group of products with clear fiscal intentions. The counterfactual of keeping Italian sugar, petroleum and coffee tariffs and

demand at the same levels in 1877 and 1889 shows how the fiscal products are responsible for more than half of the total protection increment between these two years. On the other side, the Spanish manufacture sector would be the main responsible of the Spanish return to protection between 1889 and 1897 with the textile sector as leader with an outstanding contribution of almost half of the total tariff increase followed by wheat as mayor contributor with less than a quarter of the total. Inside manufactures, consumer goods and its main component, cotton textiles, got the best protective position, even thought the steel industry was protected too(see Tena(1999). In Italy, manufacture protection was more moderate it was and the steel heavy industry and some chemicals products that improved their position inside manufacture protection(see Federico-Tena(1998). Spanish agrarian protection was more stable than that of the manufacturing sector. When the general protection index moderates, agriculture improves its position in relation with industry and, when protection increase, the opposite occurs. Spanish fiscal tariffs increased in the turn of the century but they did not affect this general outline of protection (Tena(1999).

As manufactures tend to have a the most elastic demand and fiscal products the least, this downward bias is especially relevant for those periods and countries in which revenues products reduced or increase their share in total imports in relation with manufactures. The relevance of this fact comes out in the comparative study of the Spanish and Italian case. The significant increase in the Spanish protection for manufactures is not detected by the average import weighted index meanwhile the strong increase in fiscal tariffs is reflected completely by the Italian index. Manufacture tariff increase downward bias the Spanish tariff average index of protection, and revenue tariffs increase bias up the Italian tariff average index as much as to change radically the comparative trade policy and tariff growth measures for both countries.

4. Manufacture versus Total Protection and the Tariff Growth Debate

Traditionally many authors have supported the idea that protection was instrumental to the development of Continental Europe in the late nineteenth century [15]. Supporters suggest that tariff encourage structural change from agriculture to industry to raise output per worker. Tariff may exerts two contradictory effects on growth. First one, emphasizes by

[15] For Europe many authors, like Milward –Saul (1977), Pollard (1982) but notably Bairoch (1976, 1989, 1996) and recently the already mentioned work by O`Rourke (2000) and Clemens Williamson (2001) implicitly sustain this position for the period 1875 -1914. “Although import substitution policies have gradually

import substitutions views, pulling resources into the manufacturing sector, it enlarge the scope for dynamic scale benefits, thereby increasing growth. Second one, emphasizes by free traders views, imposing a static efficiency loss, the cost of which rises over the time as the manufacturing sector becomes larger.

Then in the tariff growth debate, especially for Europe XIX century, the important question is: was protection a successful policy to foster industrialization? In consequence we should be more interested in the correlation between industrial tariff average and total factor productivity increase[16]. GDP per person growth has probably a good correlation with total productivity increase in the long run, but perhaps total tariff average is not a good proxy for relative industrial tariff average. An increment in the total average to protect agricultural producers in the aftermath of the Great grain invasion (O`Rourke (1997), or the increment of exotic goods tariffs for fiscal reasons between 1870 to 1914, suggest again caution in the use of total tariff average as protection indices in the tariff growth debate. Total tariff average may not only provide little information for interpreting the tariff mechanism causation to growth but perhaps an erroneous one .

lost their shine over the postwar period, their reputation has remained intact for the late nineteenth century" (Irwin (2001) p. 1

[16] Edwads (1998) study on "openness and growth" runs regressions of total factor productivity growth on nine alternative indicators of openness (as well as initial income and a measure of schooling).

Figure 9
Association between total tariff level in 1875 and growth in European Core countries

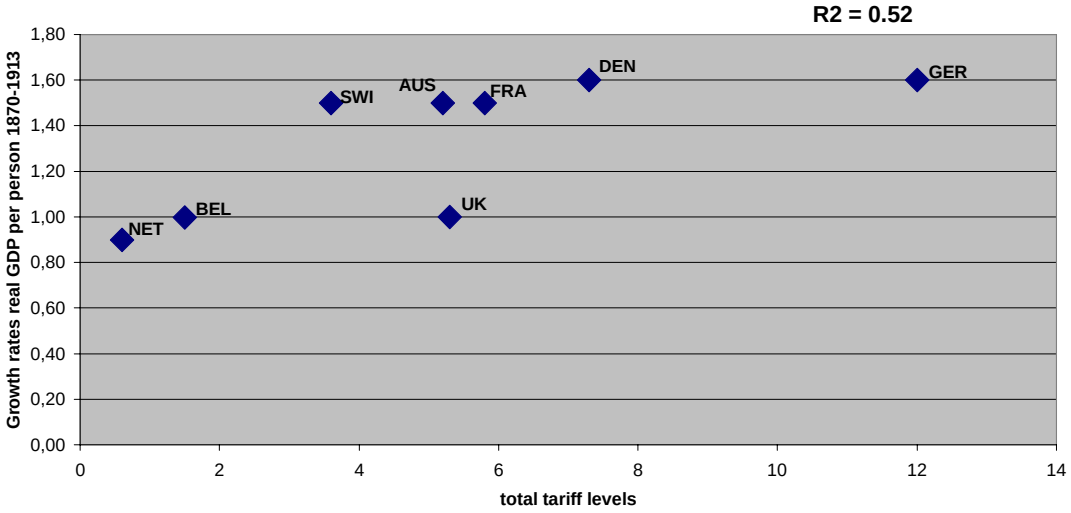
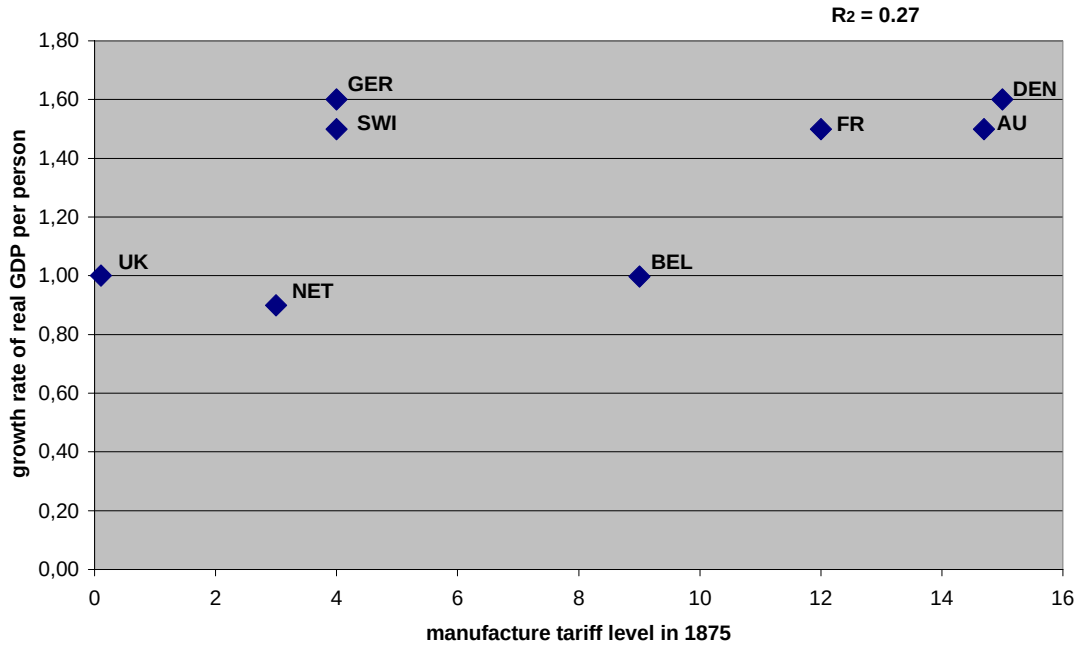


figure 10
Association between manufacture tariff levels in 1875 and growth in European Core Countries



Sources: GDP Growth rates per person Maddison (1995), table 1.3, p.23; Manufacture & Total tariff level 1870`s see Table 3.

figure 11
Association between total tariff level in 1875 and growth in European Periphery

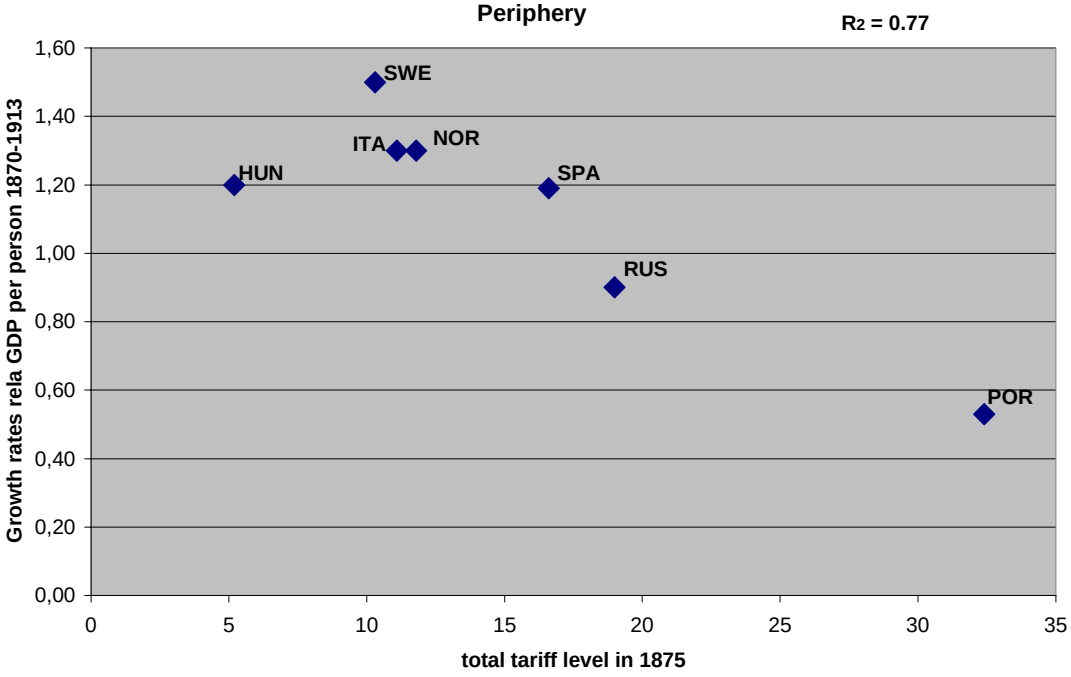
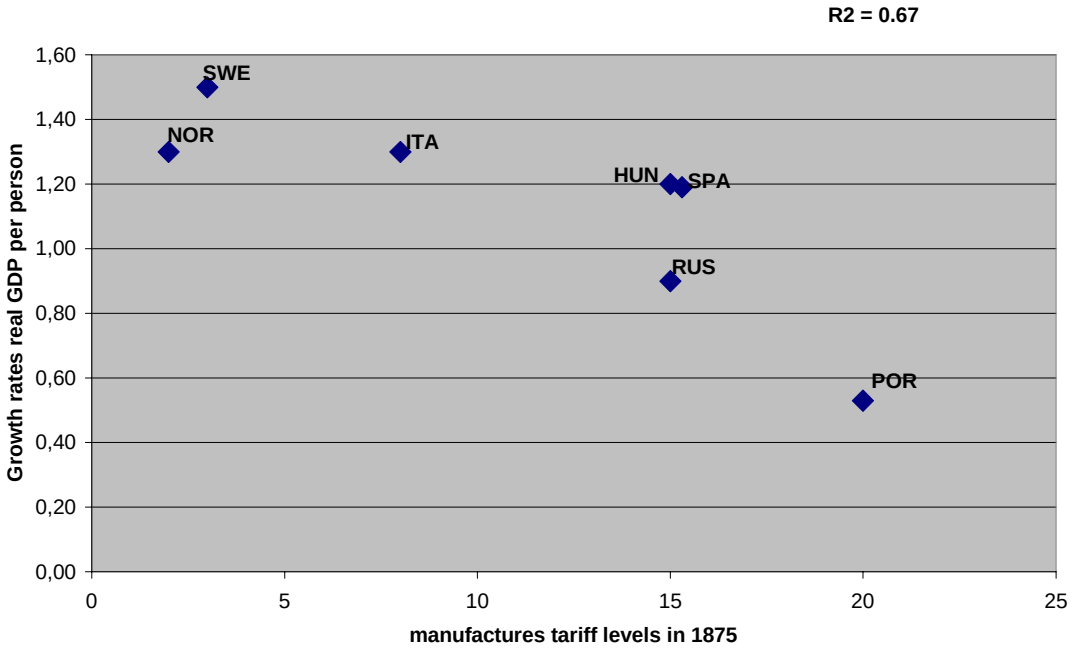


figure 12
Association between manufactures tariff level in 1875 and growth in European Peripheral countries



Sources : Growth rates Real GDP: Maddison (1995) p.23, Tariff levels 1913, see Table 3 plus United Kingdon an a division between Austria and Hungary .

figure 13
Association between the ratio industrial/total tariff and growth in European Core countries

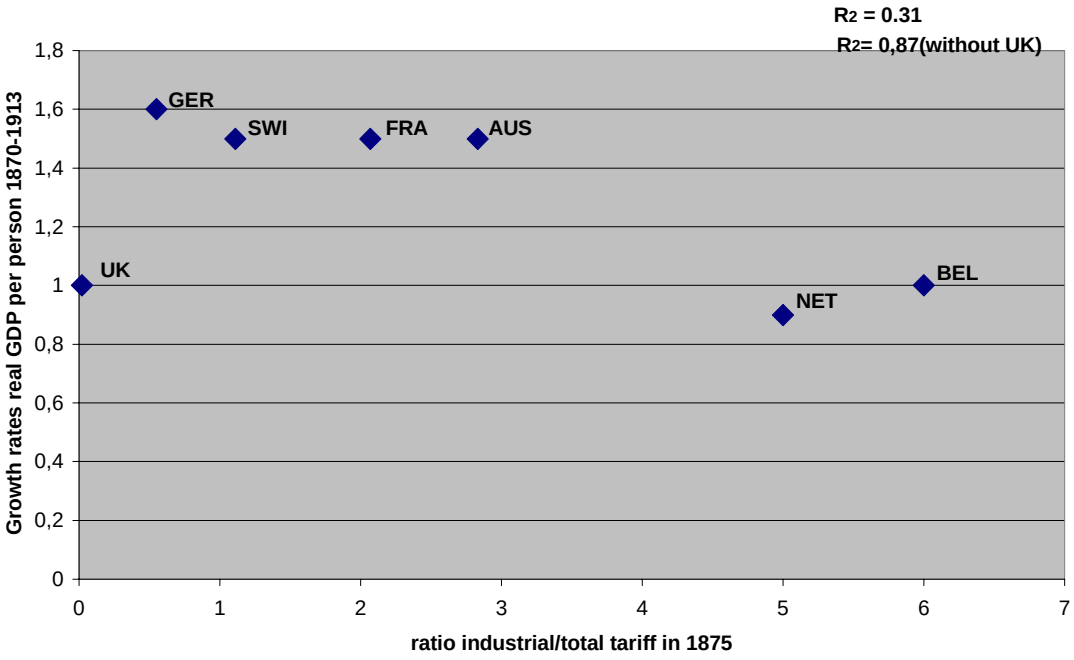
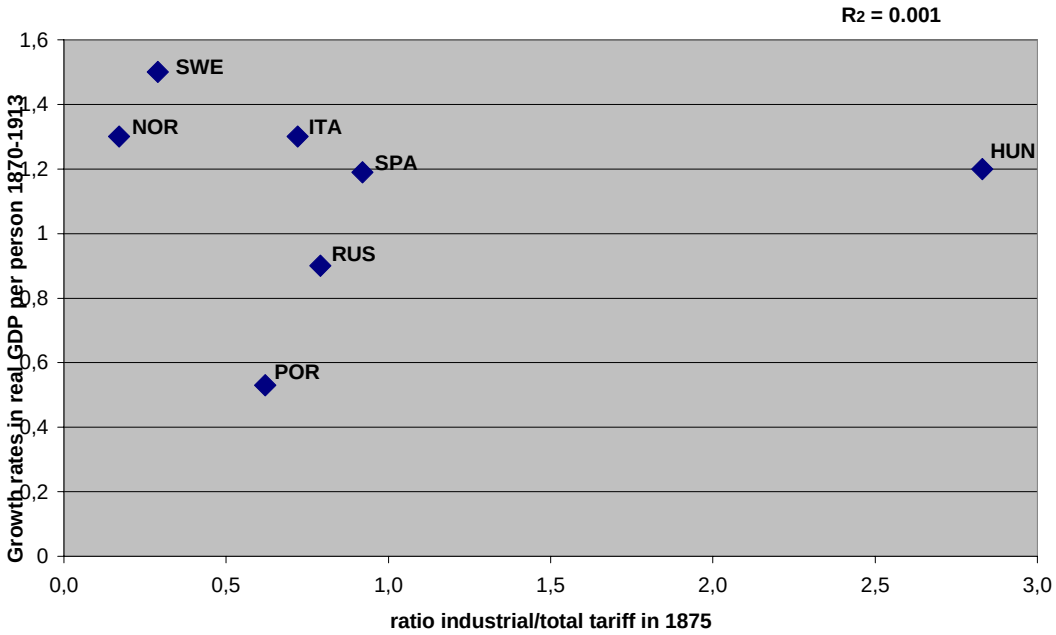


figure 14
Association between the ratio industrial/total tariff in 1875 and growth in European Periphery



Bairoch hypothesis that tariffs were positively associated with growth in late 19th century is related only with European countries but has been used for other geographical areas. The positive correlation founded recently by O´Rourcke (2000) suggests, following Bairoch, that tariffs may have played a causal role in promoting growth in the years previous to First World War even if results appear very influenced by the country sample [17]. This suggestion has been questioned, in terms of regional asymmetry, by Clements &Williamson (2001) that show how tariffs had a negative low impact on growth in the European periphery and were only positive associated in Rich European Offshoots. Association between growth and tariffs in Continental Europe seems, positive but very low and spurious.

In previous figures we have used Bairoch`s estimation of manufacture tariff levels for 15 European countries in 1875 to construct two samples of countries, Core and Periphery, according to their income level[18]. Figure 9 and 10 test rudely main Core European countries association between total and manufacture tariff level, respectively, with growth. In figure 9 the association between initial total tariff average in 1870 and the respective rate of growth for the period 1870-1913 appear clearly positive (R^2= 0.52, without UK R^2= 0.65) in relation with a doubtful low positive association between manufacture tariffs and growth (R^2= 0.27, without clear outliers), for the same group of countries in figure 10. Figure 11 and 12 reproduce the contrast between total and manufacture tariffs in association with growth for the European Periphery. Both figures show high negative correlations. Higher total tariffs appear strongly associated with slow growth (R^2= 0.77, without Hungary R^2= 0.87) and manufacture tariffs seems to confirm this negative association (R^2= 0.66). So, In one side, rich European countries growth is associated with total tariff but not with manufacture tariff increase; and in the other side, poor Europeans countries growth appear negatively associated either with total than with manufacture tariff increase.

The other important point discussed bellow is the association between relative manufacture protection and growth. Increment in total protection may be caused by

[17] "It appears that Bairoch hypothesis (that tariffs were positively associated with growth in late 19th century) holds up remarkably well". p. O´Rourcke (2000). The data set cover ten countries, three in the New World (Australia, Canada, and US) and seven in Europe (Denmark, France, Germany, Italy, Norway, Sweden and UK).

[18] Core European countries are defined according to Maddison (1995): those that in 1870 had GDP per Capita (international 1990 dollars) equal or superior to France (Core: Austria, Belgium, Denmark, France, Germany,

increments in agrarian or "fiscal" protection and in consequence may imply a reduction in relative manufacture protection. Figures 13 and 14 show the association between growth and the ratio of manufacture/total tariff for the same group of rich and poor European countries than the other figures below. Core Europeans countries growth (figure 13), show the higher industrial/total tariff ratio associated with slow growth (without UK, a strong negative correlation R^2= - 0,87) in apparent contradiction with previous positive correlation of growth with total tariffs. On the contrary, poor Europeans apparent strong negative growth association with tariffs became completely spurious when it is associated with the relative manufacture/total tariff ratio (figure 14).

Table 3

Manufacture and Total Tariff Ratio between 1870 and 1913 in Europe

1870`s	Bairoch Tariff Average1875 Manufact. (1)	Tariff Average1870 Total (2)	Ratio (3) = (1) / (2)	1913	Tariff Average1913 Manufact.(4)	Tariff Average1913 Total (5)	Ratio (6) = (4) / (5)
Austria	15	5.2	2.83	Austria	14.6	22.8	0.64
Belgium	9	1.5	6	Belgium	8.7	14.2	0.61
Denmark	*15*	*12*	1.25	Denmark*	14	9	1.55
France	12	5.8	2.07	France	12.9	23.6	0.55
Germany	4	7.3	0.55	Germany	8.5	16.7	0.51
Netherlands	*3*	*0.6*	5	*Netherlands**		*3*	
Switzerland	4	3.6	1.11	Switzerland	7.6	10.5	0.72
UK	0.1	5.3	0.019	UK*	0.1*	4.2 (2)	0.02
EU(Core)				EU (Core)			
Hungary	15	5.2	2.83	Hungary	14.6	2.,8	0.64
Italy	8	11.1	0.72	Italy	12.6	24.8	0.51
Norway	*2*	*11.8*	0,17	*Norway**		*11.4*	
Portugal	*20*	*32.4*	0.62	Portugal(2)		24.7	
Russia	15	19	0,79	Russia	79	7.5	1.09
Spain	15.3	16.6	0.92	Spain	35.7	37	0,96
Sweden	3	10.3	0,29	Sweden	22,5	27.6	0.82
EU(Periphery)				*Serbia*	*15*	*22.2*	0.68
				Rumania	*22.5*	*30.3*	0.74
				Bulgaria	*18.7*	*22.8*	0.82
				Finland	*36.4*	*35*	1.04

Sources : (1) Bairoch (1989), Table 5 p.42; (2) Mitchell (1981) Custom revenue & Import value; (4) Liepman (1938) Table IV A p.413 Industrial Manufactured goods potential tariff levels; (5) Liepman (1938) Table IV B p.415 General potential levels with fiscal goods included. * League of Nations(1927) arithmetic averages sample.

Netherland, Switzerland, UK) that had 56% of the UK level (the next Sweden with the 50%). Peripheral countries the rest (ordered by income): Sweden, Italy, Spain, Norway, Hungary, Portugal, Russia.

Table 3 use Bairoch (1989) and Liepman (1938) manufacture tariff average estimations for the respective years of 1875 and 1913 in relation with total average[19]. Apparently, in the first half of 1870´s, before the years of return to protection, rich European countries had a remarkable more protected manufactured sector than the rest of the economy. Amazing, relative manufacture protection in the same years in the European periphery was in the other way around. Even if the data, showed in table 3, has some comparability problems, it suggest that rich European countries relative manufacture tariffs ratio was reduced from 1870´s to First War World. What this crude ratio evolution may show? a) That the stimulus of industrial protection to shift resources out of agriculture and into manufacturing was reduced during the years of return of protection in most rich European countries b) That the ratio between manufacture tariffs and primary product tariffs worsened because some primary products tariffs used by fiscal reasons increased faster than the rest agricultural and industrial duties but the stimulus to shifting resources out of agriculture may be increased. Revenue and protective products tariffs appear, again relevant to the tariff growth debate.

Evidence showed in this section appear quite contrary to Bairoch (1977,1989,1996) traditional hypothesis on the positive role that protection played to foster Continental Europe industrialization before First War World. Nevertheless, the proposal of this section it is more a suggestion to additional research to explicit the relation between industrial, agricultural and fiscal tariffs to clear the mechanism of causation between tariffs and growth. As Irwin (2001) mention correlation between tariffs and growth are only suggestive of causality. To establish causal relationship it is necessary to "determine if high tariffs stimulated growth by shifting resources out of agriculture and into manufacturing"(abstract).

Conclusion

This study suggests caution on the use of average tariffs for comparative commercial history. Firstly, because in practice there are no pure fiscal tariffs neither pure protective

[19] Manufacture tariff average of Bairoch and Liepman are not directly comparable across the time because they use different methodology. Bairoch estimation use a sample of 14 different manufactured products duties in 1875 weighted by import values average of 1869-71(as usual he is not much more explicit about his estimations). Liepman methodology is very well known. He use a simple average of 61 manufactured products in 1913 over export prices in the same year . On the contrary the ratio between Manufacture and total tariff average in each period is perfectly comparable because both follow a similar methodology with some explicit exceptions in 1913.

ones, but those who have a small elasticity of demand (fiscal ones) have much less impact on welfare than those with high elasticity. The strong and changing presence of the so-called fiscal products throughout trade history makes this point important in the analysis of the comparative evolution of the international commercial policies and in the appreciation of the relative industrial , agricultural tariff ratio. So we need to know the share of fiscal tariffs and excise compensation through the time to qualify, at least, the average tariff trend. Nye´s provocative tariff average comparison is a good cautionary tale in this direction. Secondly, average tariffs estimated may contain an important bias as measurement of protection because of classic index number problems. As manufactures usually have the most elastic demand products and foodstuff products the least, this downward bias is especially relevant for those periods and countries with high levels of manufacturing protection, and also for those periods and countries in which revenues products reduce or increase their share in total imports relative to manufactures. Third, this paper also investigate the mechanism causation between tariffs and growth. New evidence suggest different correlation between total and manufacture tariffs and growth. Association between tariff and growth reveals a development asymmetry specify for the case of Europe. Bairoch´s hypothesis on tariffs fostering Continental Europe industrialization at the end of nineteenth century appear not to holds up for peripheral or even core European countries. This paper suggest caution in the use of the conventional average tariffs and the need to estimate some kind of separate cross country industrial, primary and fiscal products tariff average as a necessary contribution for a better defined tariff growth debate.

In an already mentioned paper O`Rourke recognize that "the average tariff measure which I am using is extremely crude, and may in some cases be misleading, for reasons highlighted earlier….. The construction of a superior index of protection, on an uniform basis, for as many countries as possible during the late 19th century should be a major research priority" O`Rourke (2000), p.17. This paper has been stimulated for O`Rourke´s statement and it contribution consist on clarification on the main variables that influence the accuracy of the tariff average and the different implications of it extended use for the tariff growth debate. This paper also suggest a research agenda to investigate the mechanism between trade policies and growth.

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APPENDIX 1

FIGURE 9
EXPIRIT EXCISE RATIO AND ADVALOREM PROTECTION 1827-1913

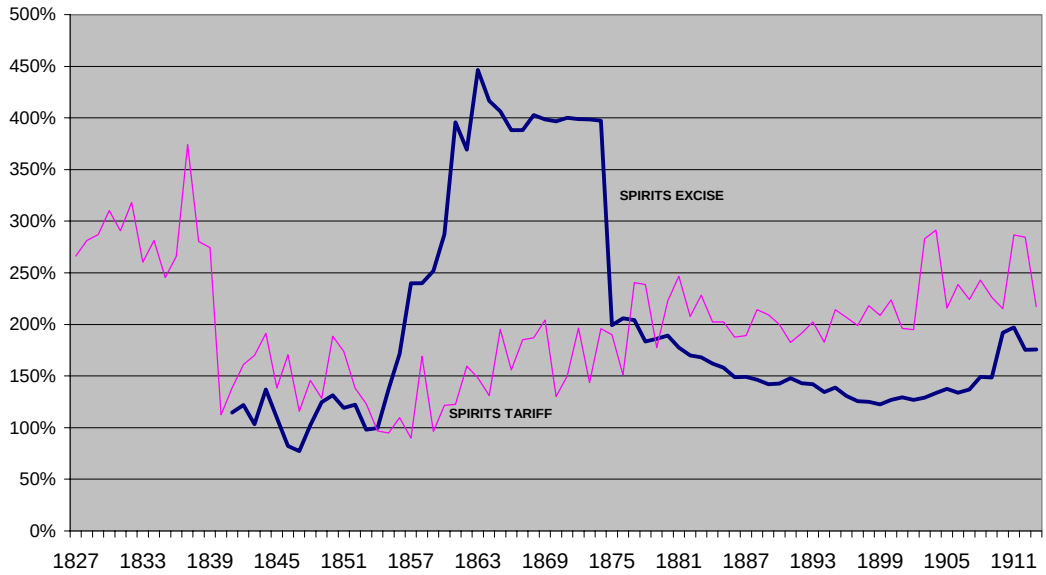
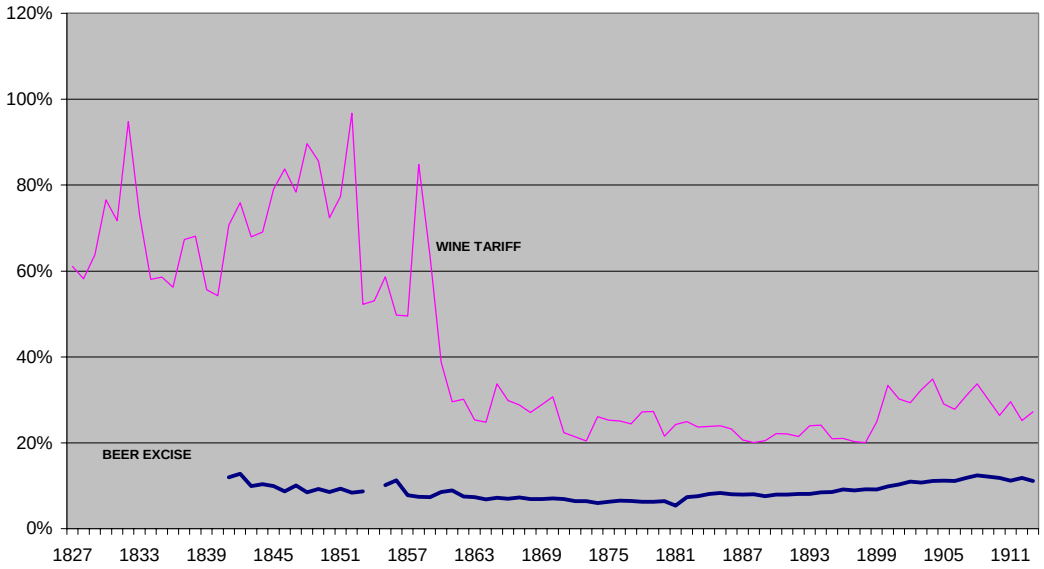


FIGURE 10
BEER EXCISE RATIO AND WINE TARIFF PROTECTION



Sources: see Appendix 1

APPENDIX 2

Sources and methods on tariffs revenues an fiscal products

UK Data on import value and customs revenue
Total import value and total costume revenue from 1827 to 1913 : Imlah (1958).

Fiscal products import value and costume revenue for: coffee, tea, sugar, tobacco, spirits and wine:
-Quantities and revenues from: *House of Commons*(1898). "Customs tariffs of the United Kingdom from 1800-1897" Vol. 85, London, and *Board of Trade, British Parlamentary Papers* 1890-1913, yearly.
-Prices for coffee, tea, sugar, tobacco, spirits and wine before 1854, using declared values from the official trade statistics of 1854 and prices index from Sauerbeck (1886) "import price index (omitting cotton& wool)".
-Quantities and prices and revenues 1890-1913, *Board of Trade* (various years) and *Annual Statement of Trade, British Parliamentary Papers* (various years).

UK Fiscal data on Excise revenue and Production
1841-1913
for Spirits and Beer & Ale from *House of Commons* (1898)
Prices: Spirits and Beer export prices from *Board of Trade* (various years).

France Data on import value and customs revenue
Total import value and total costume revenue from 1827 to 1913, from Levy-Leboyer & Bourguignon (1977). Imported Quantities and tariffs revenues for cocoa, sugar, coffee, petroleum; (1827-1895) *Tableu General du Comerce de la France* from (1896-1913) Tableu General du Comerce de la France et de la Navigations (Comerce Special).

German Data on import value and customs revenue
Total import value and total costume revenue from 1880 to 1913, from Mitchell (1981)
Data on customs revenue of coffee, tobacco, and petroleum from *Statistisches Jahrbuch fur das Deutches Reich* (1880-1913).
Data on import values of coffee, tobacco and petroleum from *Der Auswartige Handel Deutchlands in den Jahren* (various years).

Italy Data on import value and customs revenue
Italy total revenue from1864-1872: *Ragioneria Generale dello Stato* 1969 tab. 12 (Riscossioni complessive) col "dogane". 1873-1913: Repaci, R. (1962), pp.84-85 e 208.
Total Import value and Import value and tariff revenue from sugar, coffee, petroleum from *Movimento Commerciale dall Italia* (yearly).

Spain Data on import value and customs revenue
Total import value between 1850-1913 new serie estimated by Prados de la Escosura(1986).
Total revenue from *Estadísticas del Comercio Exterior* (yearly). The revenue of a tax imposed on foreign sugar and paid in frontier between 1882-1898 is also included. Import value and tariff revenue between 1850-1913 of sugar, coffee, cacao, petroleum from

Estadísticas del Comercio Exterior (yearly). Sugar revenue 1882-1898 Martín: (1982), Cuadro c.3, p.349.

APPENDIX 3

Decomposition of changes in Total Nominal Protection [NTt-NTt-1] (i)

$$NTt = \sum_{i=1}^{n} (Q_{it} * T_{it}) / \sum_{i=1}^{n} (Q_{it} * P_{it}) \quad [1]$$

$$RNTt = \sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t-1}) \quad [3]$$

$$RNPt = \sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t}) \quad [5]$$

[NTt-NTt-1] = [NTt-RNPt] + [RNPt-RNTt] + [RNTt-NTt-1] [4]

[NTt-NTt-1] = Quantity Eff. + Price Eff. + Tariff Eff. [4]

$$\text{Quantity Eff.} = \left[\sum_{i=1}^{n} (Q_{it} * T_{it}) / \sum_{i=1}^{n} (Q_{it} * P_{it}) \right] - \left[\sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t}) \right]$$

$$\text{Price Eff.} = \left[\sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t}) \right] - \left[= \sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t-1} \right]$$

$$\text{Tariff Eff.} = \left[\sum_{i=1}^{n} (Qi_{t-1} * Ti_{t}) / \sum_{i=1}^{n} (Qi_{t-1} * Pi_{t-1}) \right] - \left[\sum_{i=1}^{n} (Q_{it-1} * T_{it-1}) / \sum_{i=1}^{n} (Q_{it-1} * P_{it-1}) \right]$$

[i] The problem has been recently dealt with by Crucini (1994). However, his approach is less accurate insofar as it takes into account the duty and price effects only.